



NASA STTR 2017 Phase I Solicitation

T1.02 Detailed Multiphysics Propulsion Modeling & Simulation Through Coordinated Massively Parallel Frameworks

Lead Center: MSFC

Participating Center(s): SSC

Technology Area: TA1 Launch Propulsion Systems

Detailed modeling and simulation to assess combustion instability of recent large combustors while successful to a degree showed the need for significant advances in two-phase flow, combustion, unsteady flow, and acoustics.

Additionally, simulation of water spray systems for launch acoustic sound suppression and test stand rocket engine acoustic sound suppression showed the need for advances in two-phase flow, droplet formation, and particulate trajectory. In these cases, and others, the need for improved physics based models is accompanied by the requirement for high fidelity and computational speed.

Rocket combustion dynamic simulations are 3D, multiphase, reacting computations involving the mixing of hundreds of individual injection elements which require a long time history to be computed. Methods are sought (VOF, SPH, DNS/LES, PIC, etc.) to accurately capture the physics of the injection elements in a computationally efficient manner. Experimental validation of individual submodels are required.

NASA successfully leveraged advances/ innovation in computer science technology to leapfrog the barriers to massive parallelism via the adoption of the Loci framework in the late 1990's. Computer science has evolved in the last two decades with respect to technology of massive parallelism. The intent of this subtopic is to infuse newest technologies, i.e., improved physics based models accompanied by the requirement for high fidelity and computational speed, into tools for propulsion related fluid dynamic simulation. This solicitation seeks simultaneously coordinated computer science (CS) technology advances, multi-physics (MP) simulation, and high fidelity (HF) models. The value and requirement for proposals is this coordinated CS-MP-HF framework. Ideally, technologies that are up to this point only Lower TRL demonstrations are strong candidates if they are developed to fit in a coordinated CS-MP-HF framework that can be applied to propulsion system fluid dynamics.

Tools developed in this framework are expected to enable propulsion system production & DDT&E cost reductions.